High Fidelity Computational and Wind Tunnel Models in Support of Certification Airworthiness of Control Surfaces with Freeplay and Other Nonlinear Features, Phase I

Completed Technology Project (2011 - 2011)

Project Introduction

The proposed work will establish high fidelity computational methods and wind tunnel test model in support of new freeplay criteria for the design, construction and controlled actuation of control surfaces with varying amounts of freeplay and their aeroelastic response. These methods will be validated with wind tunnel and flight test data. In Phase I a nonlinear computational aeroservoelastic methodology will be developed for freeplay induced flutter/LCO and gust response. Validation will be achieved by comparisons with legacy and new wind tunnel test data. In Phase II the methodology will be generalized to create a mature software capability for closed-loop aeroelastic systems in the trimmed/untrimmed state including gust, stick or random aeroacoustic excitations. An all movable tail wing wind tunnel test article will be designed and built with variable freeplay with initial test evaluation completed in Phase I and a thorough parameter variation data set and will be developed in Phase II for computational code validation in Phase II. Subject to available funding constraints both high speed transonic as well as subsonic will tunnel tests will be undertaken. In Phase III the computational methodology in combination wind tunnel test results will be used to support the improvement of the current FAA and/or MIL-SPEC freeplay aeroelastic response criteria. Following the successful demonstration and validation of the new computational methods, the methodology will be proposed for adoption by FAA for commercial applications and the DOD for military applications with the expectation that all major civilian and military aerospace industries will adopt the design/analysis methodology for freeplay induced LCO/flutter prevention.

Primary U.S. Work Locations and Key Partners

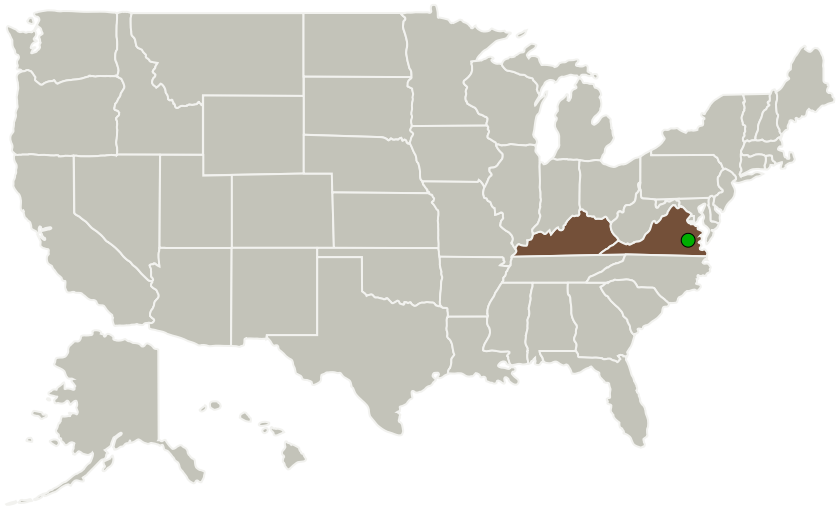

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Table of Contents

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Organizations Performing Work	Role	Type	Location
Advanced Dynamics, Inc.	Lead Organization	Industry Minority-Owned Business	Lexington, Kentucky
Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

Primary U.S. Work Locations	
Kentucky	Virginia

Project Transitions

February 2011: Project Start

September 2011: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/138202)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Advanced Dynamics, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

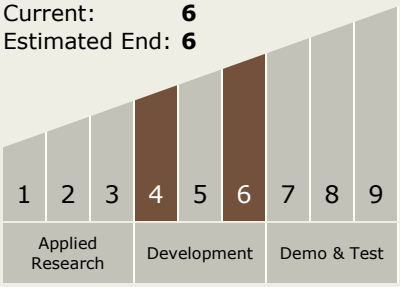
Carlos Torrez

Principal Investigator:

Patrick Hu

Technology Maturity (TRL)

Start: **4**
Current: **6**
Estimated End: **6**



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Technology Areas

Primary:

- TX15 Flight Vehicle Systems
  - TX15.1 Aerosciences
    - TX15.1.3 Aeroelasticity

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System